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ISO 9001 SABS

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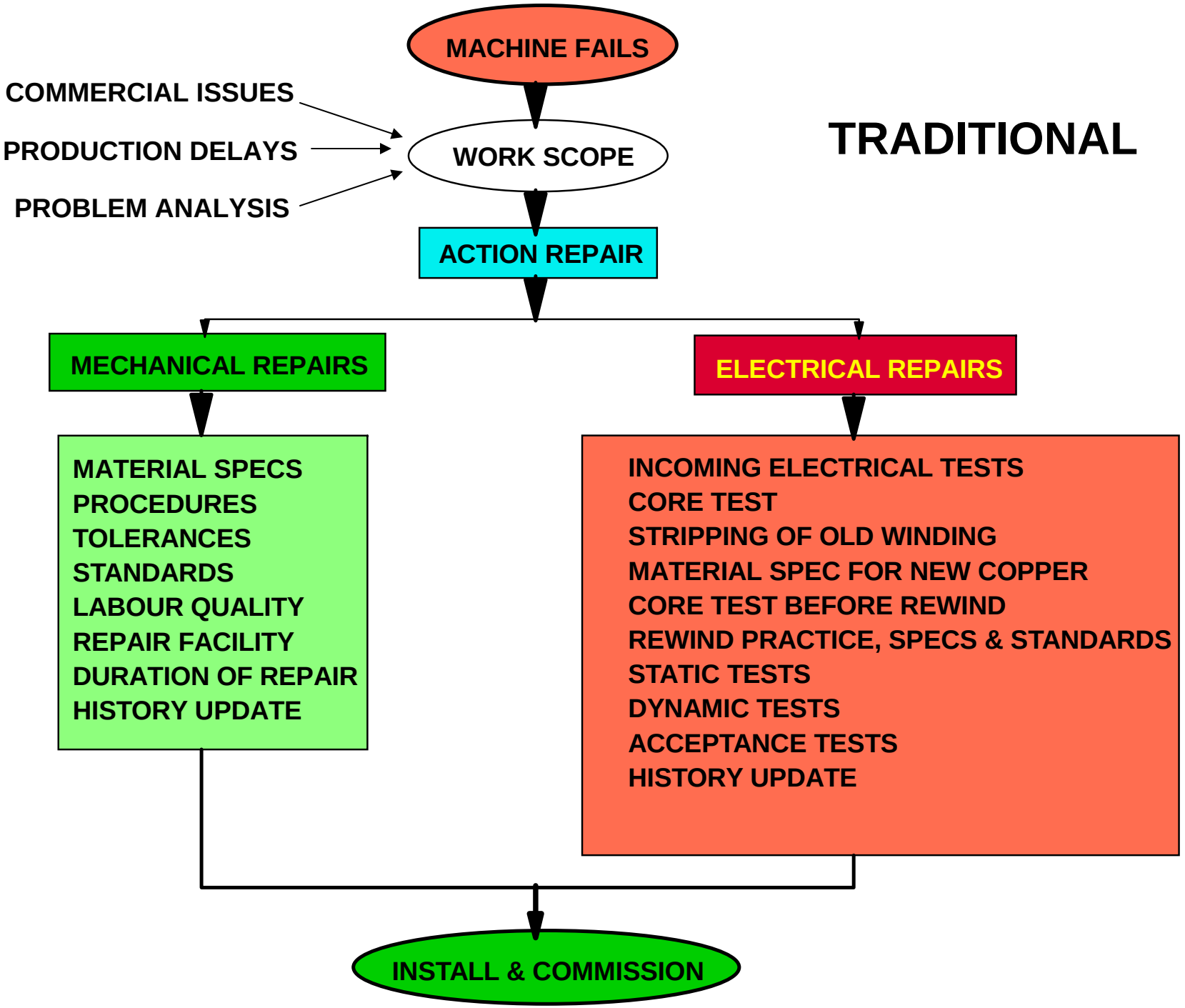
CUSTOMER SERVICE

LHM ROTATING MACHINES CONFERENCE 2004

MACHINE REPAIRS


MACHINE FAILS
COMMERCIAL ISSUES
PRODUCTION DELAYS
PROBLEM ANALYSIS
WORK SCOPE
TRADITIONAL
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CORE TEST BEFORE REWIND
REWIND PRACTICE, SPECS & STANDARDS
STATIC TESTS
DYNAMIC TESTS
ACCEPTANCE TESTS
HISTORY UPDATE
INSTALL & COMMISSION

NEW ISSUES

REPAIR OR REPLACE – WHEN, HOW?

WHAT STANDARDS SHALL APPLY?

WHAT EFFICIENCY IS ACCEPTABLE?

AT WHAT COST?

POWERFACTOR?

HARMONICS? (CONTAMINATION OF WEAK GRID)

MAIN CAUSES OF FAILURE

1. MECHANICAL – **MISALIGNMENT, ETC**

2. ELECTRICAL – **INSULATION FAILURE**

PROBLEM – TOO MUCH HEAT IS GENERATED,

LEADING TO BEARING FAILURES, JOURNAL FAILURES,

CORE FAILURES, CONDUCTOR FAILURES,

INSULATION FAILURES.

MECHANICAL FAILURE

100% OF THE TIME CAUSED BY EXCESSIVE HEAT

AS A RESULT OF FRICTION BETWEEN PARTS.

ELECTRICAL FAILURE

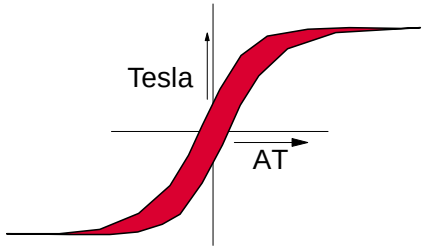
100% OF THE TIME CAUSED BY EXCESSIVE HEAT

AS A RESULT OF OVERLOADING, PARASITIC CURRENT, HARMONICS, EDDY CURRENT, INSUFFICIENT DIELECTRIC STRENGTH OF INSULATION, SATURATION OF MAGNETIC PATHS, HYSTERESIS LOSS, EXCESSIVE CURRENT DENSITY IN CONDUCTORS.

LOSSES

1. **CORE LOSS (15 – 25% of Total Losses)**
   a. **Hysteresis – The energy necessary to change the direction of the magnetic field.**

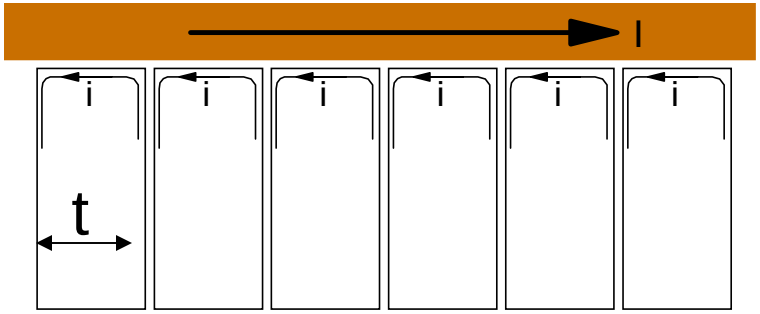
Cure – Use low carbon steel or silicon steel.



$Ph \alpha \eta.Vol.\ F.B^2max$

   b. **Eddy Currents – Stray currents found in ferromagnetic materials as magnetic fields are induced into them.**

Cure – Use thin insulated laminations.



$Pe \alpha F^2 \times t^2 \times Vol \times B^2/\rho$

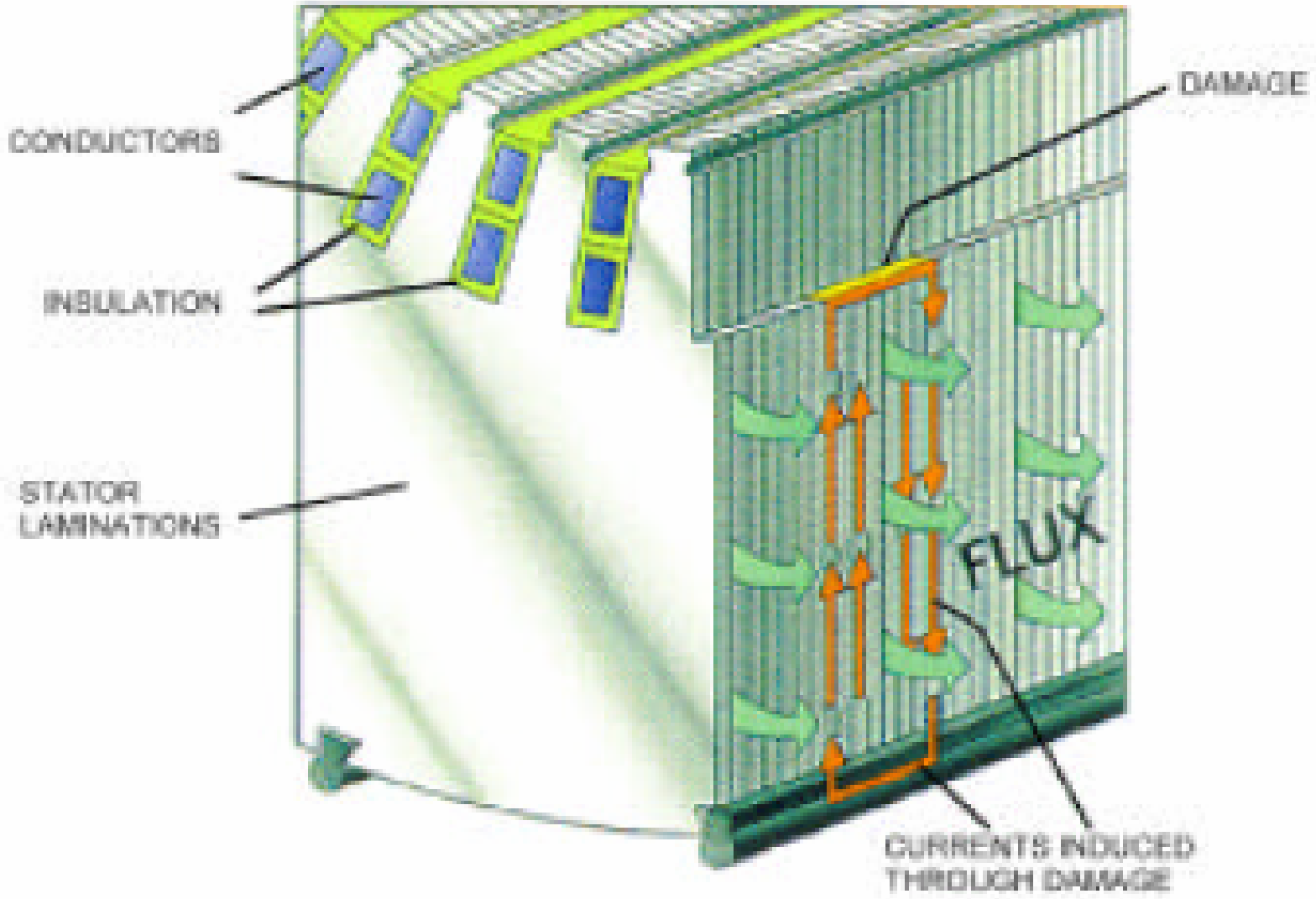


Fig 1 Eddy currents induced in a laminated core due to inter-lamination damage at the base of a slot

LOSSES (cont.)

2. **Windage & Friction (5 – 15% of Total Losses)**
   Due to air density, turbulence within the stator, bearings, fans and anything causing a friction force on the shaft like mis-alignment, seals etc.

3. **Stator Losses (25 – 40% of Total Losses) – I^2R**
   Due to current flow through the stator winding.
   Reduce by increasing conductor size.

4. **Rotor Losses (15 – 25 % of Total Losses) – I^2R**
   Due to current flow in the rotor conductors and end rings / - windings.

5. **Stray Losses on No-Load and on Load (10 – 20%)**
   Due to leakage, harmonics, & other unaccountables.

EFFICIENT REPAIR PHILOSOPHIES.

MECHANICAL REPAIRS.

USE BETTER MATERIALS WITH LOWER COEFFICIENT OF FRICTION AND THAT CAN WITHSTAND HIGHER OPERATING TEMPERATURE AT ELEVATED SPECIFIC LOADING.

NEW LUBRICANTS
CERAMICS
MAGNETIC BEARINGS
IMPROVED ALIGNMENT METHODS
ETC.

EFFICIENT REPAIR PHILOSOPHIES.

ELECTRICAL

IMPROVED METHODS OF STRIPPING WINDINGS, MECHANICAL STRIPPING OR HEAT CLEANING?

IMPROVE CORE MATERIAL BY USING MODERN SILICON STEEL AND THIN LAMINATIONS.

IMPROVE DESIGN BY UTILISING MODERN DESIGN PHILOSOPHIES AND NEW MATERIALS FOR INSULATION.

ENSURE THAT CONDUCTOR SHAPE AND CROS-SECTION WILL NOT MODIFY MACHINE CHARACTERISTICS ADVERSELY.

DO NOT INCREASE AIR GAP BY SKIMMING ROTOR OR LINE BORING STATOR UNNECCESARILY.

MODERN PROCESSES LIKE VPI CAN IMPROVE EFFICIENCY.

HIGH EFFICIENCY ?

1. DO YOU RUN AT OPTIMUM LOAD FOR THE MACHINE?

   IF NOT – USE A STANDARD MACHINE

2. IS THE MACHINE SUPPLY VOLTAGE AT ITS DESIGN VALUE?

   IF NOT – YOU LOOSE OUT

3. DO YOU HAVE A CLEAN SUPPLY ON THE MOTOR TERMINALS?

   IF THE HARMONIC CONTENT IS HIGH – YOU LOOSE.

4. DID YOU CHECK IF THE MACHINE STILL COMPLIES AFTER

   IT WAS REPAIRED.